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DETERMINANTS OF CZECH DISPOSABLE HOUSEHOLD INCOME AND RELATED HOUSING QUALITY

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Abstract

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Disposable household income is one of the basic indicators of living standards. This paper deals with what socioeconomic factors affect such income and predetermine how the population is stratified by income level. It goes on to reveal the connections between household income and housing quality parameters. There is a visible difference in living standards between different income groups of the population. Data mining techniques were used to examine data from the EU-SILC surveys for 2005, 2010 and 2014.

Keywords: disposable income, housing quality, data mining, EU-SILC

INTRODUCTION

The income situation is a fundamental determinant of the standard of living of the population, a telling sign of the socio-economic status of society. For these reasons, living conditions are the focus of interests of much research. Income allows people to meet their needs, as well as many important life goals. Income goes on to affect the level of education, health and safety and other aspects in society (OECD, 2011).

When monitoring the trends for income indicators, the most suitable base variable is deemed to be disposable income. This is the flow of money into the household, which is the sum of wages, investment yields, real-estate lease earnings and social benefits (child benefit, etc.), after deducting income and capital gains tax and social security contributions paid by an employer, a self-employed or an unemployed person. Income is also often considered to be equivalised income, which reflects the income per person in the household according to status (e.g. distinguishing between the head of the household and a child) (Keeley, 2015).

Monitoring disposable income allows for further analysis. The income situation of households is an indicator depending on many factors in relation to the standard of living. An insufficient income situation leads to an undesirable social phenomenon, namely a rise in the number of households at risk of poverty (Stávková *et al.*, 2013).

Deaton (1997) also states that the main reason for collecting data on income and household consumption is to provide information on the standing of the given society and to determine, e.g. the degree to which that society is at risk from poverty.

Also Halleröd and Larsson (2008) advise that income is used to determine poverty, which they perceive as being the inability to make ends meet, but also serves to quantify the material deprivation and social exclusion endangering some groups of society due to uneven income distribution. Income inequality was discussed by Chakravarty (2009), who defines it as the difference in income between residents in the same population, and further notes that income inequality is being targeted by policymakers who realize that the inequality in income has an impact on societal trends and social outcomes.

I: *Number of households in the EU-SILC survey in the CR*

	2005	2010	2014
Number of households on file	4,351	9,098	8,053

Income inequality is the point of departure for Haughton and Khandker (2009), who define poverty as deprivation of prosperity and specify it in more detail as poverty in housing, food or poverty in aspects of health, while setting out the main reasons why poverty must be monitored, the need to keep the poor in mind, to focus appropriate intervention measures, track projects and policies prepared for the poor and to evaluate the effectiveness of the institutions set up to help the poor.

Household income is also seen as one of the factors behind consumer behaviour and is thus often given in relation to household expenditure. Lux (2000) examined whether the structure of expenditure varies with income and came to the conclusion that the lowest income households spend most on housing and food, while the richest households can afford to spend money on clothing and leisure, or rather that the leisure category represents the greatest percentage segment of expenditure in that group.

The aim of this paper is to determine the socio-economic factors that affect the income situation of Czech households and thus predetermine their places in income categories, while also determining their living conditions.

Furthermore, it is to identify the determinant factors of housing quality, which derive from the given income group and set the standard of living of households, as well as to recognize the strong ties between the housing quality parameters and income.

MATERIALS AND METHODS

The main source of data for this study is the EU-SILC project database (European Union Statistics on Income and Living Conditions). This is a survey mandatory for all Member States of the European Union. In the Czech Republic it falls to the Czech Statistical Office (CZSO). The data are obtained by random sampling of the income and living conditions of households, and provide representative data on the income situation of households. Included in the dataset are also data about the quality of housing, the household amenities available for long-term use, etc. In this paper we utilize data from the years 2005, 2010 and 2014 relating to the living conditions of Czech households.

The dataset covers a number of indicators that describe the standard of living of the population. This paper is chiefly concerned with equivalised household income. This is a conversion of the disposable income that allows comparisons between households, and this by means of a coefficient determined by the CSO where the population of the Czech Republic is reflected.

The equivalised income calculation takes into account the number of members in the household and also the age profile. Also important is the so-called consumer unit recalculation. According to EU definitions, the head of the household has a coefficient of 1.0, children under the age of 13 have 0.3 and other children and other persons 0.5. The consumer unit calculation equation is the following:

$$EJ_{DEF.EU} = 1 + 0.5 * (n_{ADULT} - 1) + 0.3 * n_{CHILD}$$

Based on the calculated consumer unit coefficients, the household income is calculated per equivalised household member. Equivalised income is calculated as a share of disposable income of households, as defined by the EU in CZK per year and by the number of consumer units.

First we need to rule out the attributes unrelated to income, or those that are just another expression of the level of household income. The primary dataset is cleared of irrelevant data, the resulting file is then divided into two parts: the indicators that affect household income, and the indicators that are affected by income. With the data thus segregated, experiments are designed and run.

Using machine learning algorithms, the strength of the correlation between indicators and levels of household income is determined and subsequently those indicators that do not add any or very little informational value in relation to the level of household income are removed. The objective for this part of the process is to find the regression value, in conjunction with the methods of attribute extraction and selection. For testing purposes we devise a set of algorithms to test, and for the resulting calculations we use those that return the most accurate results for the given dataset. The dataset needs to be split into the test and training subsets. The regressor is then trained on the training subset and its success rate put to the test on the test subset. This is done by using cross-validation, which automatically divides the dataset into several parts. This is done iteratively, selecting one portion of the data not yet used for testing, and k-1 portions for training with. The resulting regressor is the average taken from the individual learning steps (Kohavi, 1995). This step serves to reduce the risk of overtraining. To determine the quality of the algorithms we calculate the applicability determination index (ADI) and the mean squared error.

The next task, wherein we explore the connections between the different indicators based on household income, is to use IBM SPSS

Modeler software. This includes a Web tool that serves to create tables and charts, demonstrating the strength of each connection between the dataset attributes. This tool allows us to see the connections between individual indicators and the connections between the indicators and the target attribute. We create inter-attribute relationship maps for the individual datasets. Based on these maps we can identify the typical characteristics of different types of households.

Findings

The test files contained the following attributes, which could affect disposable income:
- Place of residence: specifically, the variables region of residence, municipality size, municipality type, degree of urbanisation
- number of households in the home, number of household members, number of economically active members, number of unemployed, number of persons receiving parental allowance, number of consumer units
- Type of household: household type in terms of the family completeness, as defined by the EU and the OECD, by economic activity, education, and work intensity
- Head of the household characteristics: head of the household social class, age at marriage, age, gender, status, head of the household education and economic activity, head of the household employment type and industry sector and the number of months receiving wages

These attributes were all polled when carrying out the household surveys queried in all the reported years.

The Select Few algorithm, which came up with the best results in for 2005, revealed 20 factors that influence the level of equivalised disposable income. The ADI for this model is 0.39.

Variables designating the place of residence were excluded from the model. Factors conversely shown to be significant were the number of household members, the number economically active, and the number unemployed. The number of unemployed can be expected to show a negative correlation relative to disposable income.

Other important factors are the number of persons drawing parental allowance and the number of consumer units in the household, which are calculated as defined by the European Union, whereby the person at the head of the household has a higher coefficient than other people and the smallest coefficient applies to children aged 0–13 years.

Most of the household classifiers in addition to the type of the household by education are also confirmed as suitable explanatory variables. And, last but not least, other important factors are the characteristics of the head of the household, namely social class, age, gender, marital status, age at marriage, education, economic activity, employment type and industry sector and the number of months receiving wages.

When testing various models with different algorithms the one that came out on top used the Variance Threshold algorithm with an ADI of 0.34.

The original estimate of anticipated explanatory factors was apt, because the algorithm ruled out only 3 variables after having tested for the year 2010. In contrast with the explanatory variables of 2005, this model retained the household location parameters (region, municipality size and municipality type and also the degree of urbanisation) and conversely the attributes of the number of unemployed persons and the number of persons receiving parental benefit were found not indicative.

The most appropriate algorithm when testing the year 2014 was the Select Few algorithm with ADI of 0.35.

The model revealed as significant factors the number of household members, the number of members economically active and unemployed, the number of persons drawing parental allowance and the number of consumer units in the household. Other important variables are the household type – by economic activity, per EU and OECD assessment and also per the work intensity of the adults in the household (what proportion in months the people were economically active out of whole year).

The characteristics of the people at the head of the household are once again important. What matters is the social class of the head person, age, age at marriage, education, economic activity, employment type, industry sector and the number of months receiving wages.

Living conditions deriving from income level

The level of income that Czech households have at their disposal drives the quality of housing and living standards. Among the factors that determine the quality of housing established as part of the SILC survey are the type of house and apartment, rental type, whether the household has a bathroom and toilet, number of habitable rooms, total apartment area, whether there are problems with the status of an apartment or house in terms of damp, lack of light and space, noise, dirt, vandalism and crime. The SILC goes on to establish household amenities for long-term use, which include a washing machine, a colour television, a computer, internet access, a telephone and a car.

SILC data enables us to learn the financial situation of households in greater detail, whether the household is burdened with a mortgage whether in arrears for rent, heating, electricity, gas and water, whether in arrears with mortgage payment or repayment of loans and credit. Also polled is which products/services the household can afford – food (meat, fish, poultry) every other day, a week long holiday away from home, covering unexpected expenses, purchasing new clothes or new furniture.

To gain commensurate understanding of the quality of housing and equivalised income, the datasets from the years 2005, 2010 and 2014 were grouped by equivalised income with a 100,000-unit interval span. Each year was thus segmented into some 10 bands. The strongest relationships were evident from the 2nd to the 5th income band.

To ascertain the relationships sought, we used the Web tool in the SPSS Modeler software. The tool serves to identify the strength of ties between the attribute values for the dataset. This also caters for using what are called Directed webs. These webs allow us to see the strength of the connections between attributes with reference to one specific attribute (IBM, 2012). In this study the tool was used to distinguish the properties of individual households with reference to equivalised income.

The tool is used primarily to create charts, but SPSS Modeler does not allow many options to modify the resulting charts, and when many variables are used the charts become hard to make out. Nevertheless, apart from charts the Web tool also generates tables. For these reasons, the results were visualized using network graphs created from these tables using the igraph tool (*igraph. org*). The respective equivalised income bands are colour-differentiated. The edge values represent the number of connections, whereby a larger number represents a stronger connection and the node values represents the respective variables studied and their values.

For the purposes of this paper, only the strongest connections were selected with a number of connections in excess of 200.

2005:

In the table of strong connections between the quality of housing and equivalised income factors we see a difference between the second and third income bands. The poorer second band, with an annual income in the range 50,000 to 149,999 CZK, unlike the higher-income third band does not own a computer, has debts for electricity, gas and water, cannot afford to pay for an unexpected expense (6,000 CZK) and cannot afford to take a week's holiday away from home.

From the 5th income band, i.e. 350,000 CZK and greater, such strong relationships are not apparent.

Strong relationships, i.e. 200 and more connections between housing parameters and income are shown in the Fig. 1.

2010:

For 2010, more connections were found between quality of housing and equivalised income factors, which showed up even in the fifth band. As in 2005, the lower standard of living for the second band, with an annual income of between 50,000 and 149,999 CZK is apparent, in this group there are many strong connections indicating that the group can't afford a computer, a car, a holiday away from home or to cover the cost of an unexpected expense (8,500 CZK).

The more connections revealed in 2010 in comparison with the year 2005 are reflected in the Fig. 2.

2014:

As in 2010, the connections show that a household in the 149,999 CZK income band does not own a computer, car, cannot go on a week's vacation away from home and can't afford to pay for an unexpected expense (9,600 CZK). Other groups with higher incomes do not have these issues, their standard of living is higher.

II: *Connections between housing parameters and equivalised income 2005*

Equivalised income	2nd Band 50,000–149,999 CZK	3rd Band 150,000–249,999 CZK	4th Band 250,000–349,999 CZK
Type of house	Terraced house	Apartment block with 10 or more apartments	Apartment block with 10 or more apartments
Type of apartment (legal usage category)	Own house	Own house	-
Type of rental	-	-	-
Bathroom and toilet	Yes	Yes	Yes
Number of rooms	3	3	-
Apartment area	-	-	-
Damp	No	No	-
Lack of light	No	No	-

Equivalised income	2nd Band 50,000–149,999 CZK	3rd Band 150,000–249,999 CZK	4th Band 250,000–349,999 CZK
Lack of space	No	No	-
Noise	No	No	-
Dirt	No	No	-
Vandalism and crime	No	No	-
Washing machine	Yes	Yes	Yes
Colour TV	Yes	Yes	-
Computer	No	Yes	-
Phone	Yes	Yes	Yes
Car	Yes	Yes	-
Rent arrears	No	No	-
Arrears for heat, electricity, gas and water payments	Yes	No	-
Mortgage debts	No	No	-
Arrears on loans and credit repayments	No	No	-
Meat every other day	Yes	Yes	-
Week-long holiday away from home	No	Yes	-
Covering an unexpected expense	No	Yes	-
New clothes	Yes	Yes	-
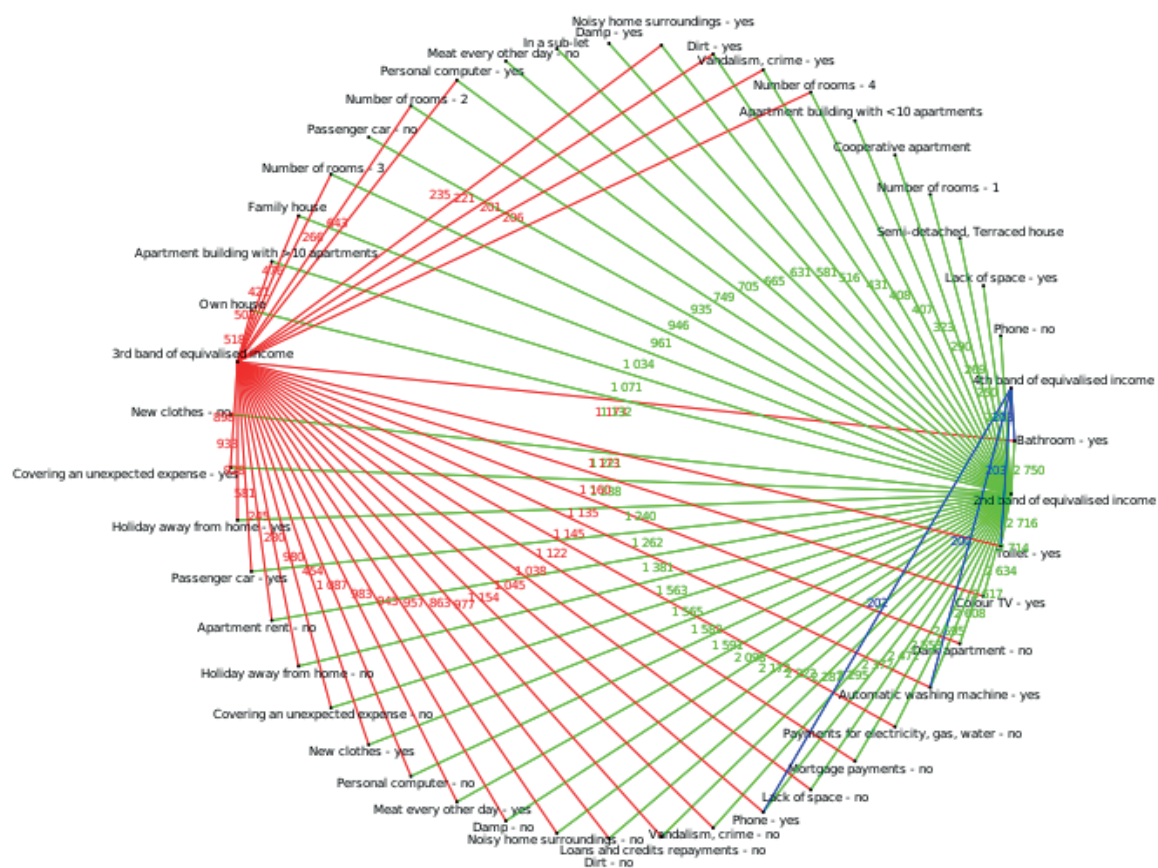
1: *Connections between equivalised income bands (EKVI_SKUP) and housing parameters 2005*

2: *Connections between equivalised income bands (EKVI_SKUP) and housing parameters 2010*
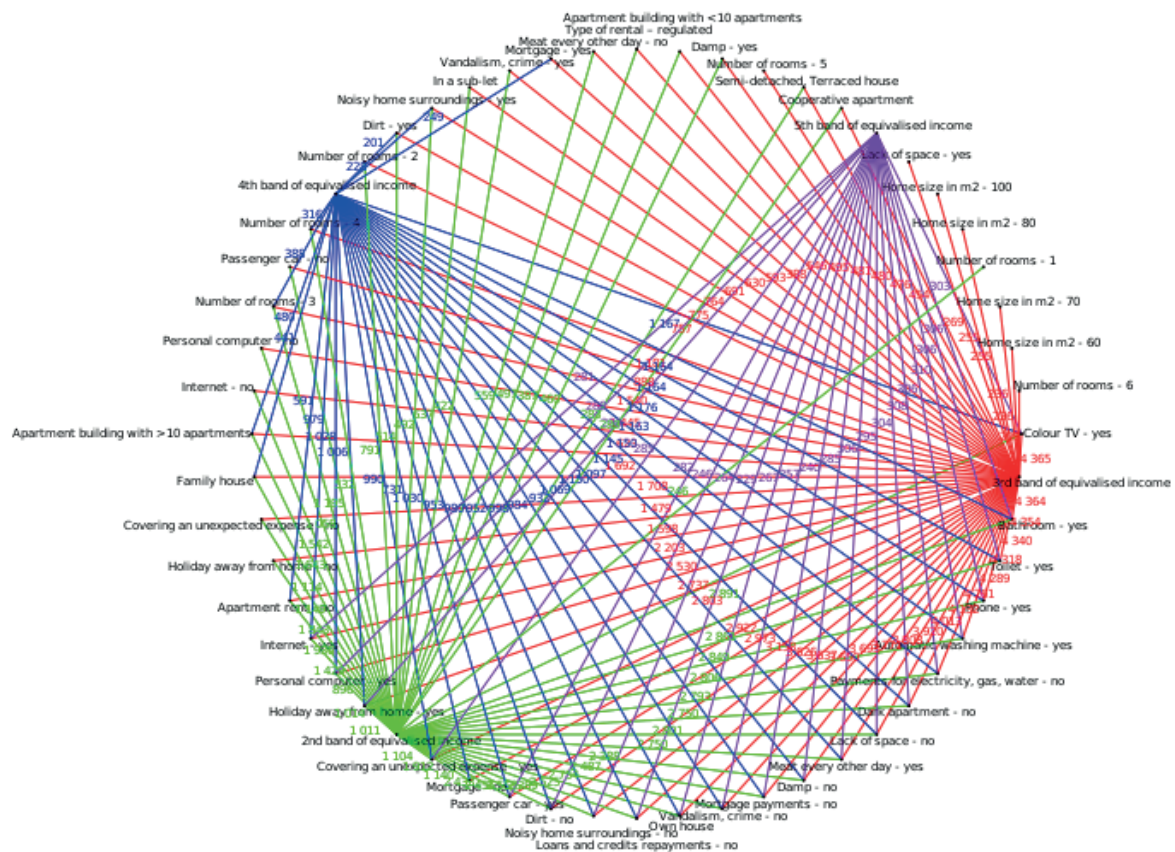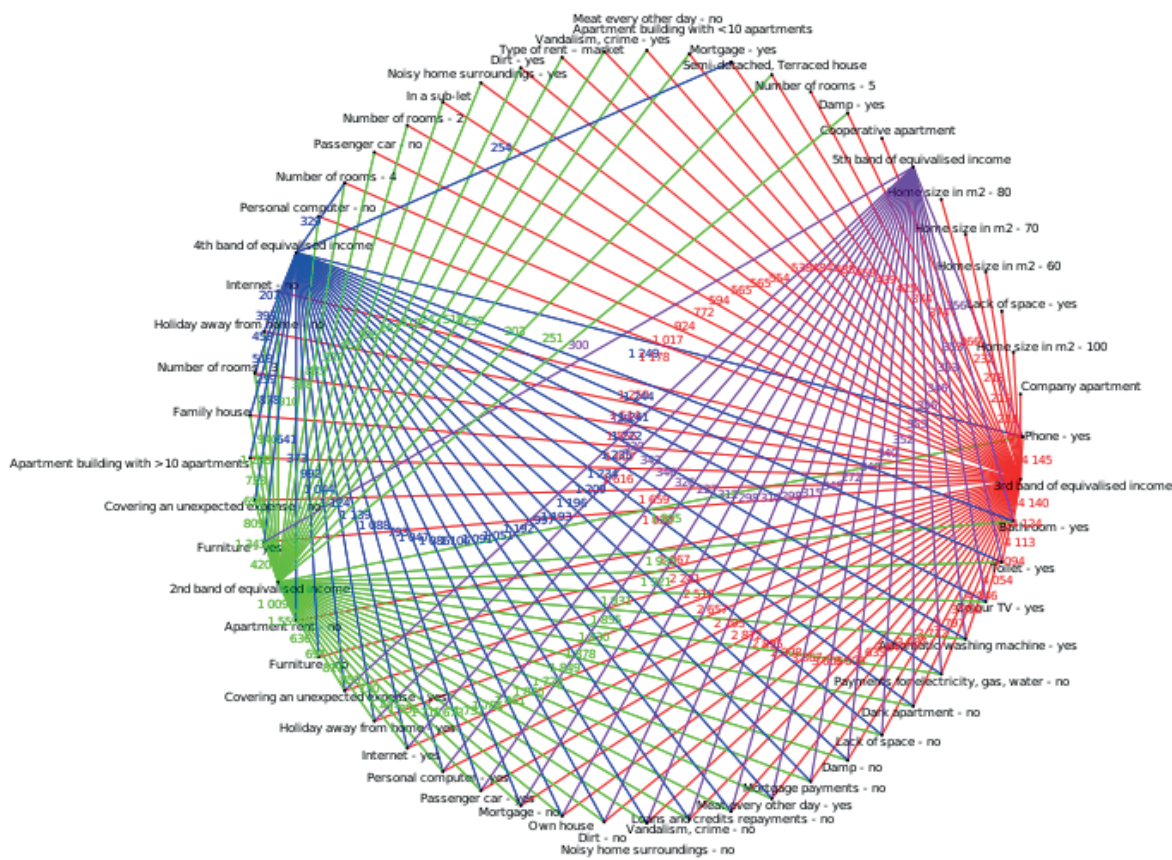
III: *Connections between housing parameters and equivalised income 2010*

Equivalised income	2nd Band 50,000- 149,999 CZK	3rd Band 150,000- 249,999 CZK	4th Band 250,000- 349,999 CZK	5th Band 350,000- 449,999 CZK
Type of house	Detached family house	Detached family house	Apartment block with 10 or more apartments	-
Type of apartment (legal usage category)	Own house	Own house	Own house	-
Mortgage	No	No	No	-
Type of rent (if rental apartment)	Market	Market	Market	Market
Bathroom and toilet	Yes	Yes	Yes	Yes
Number of rooms	3	3	3	-
Apartment area	-	100	-	-
Damp	No	No	No	No
Lack of light	No	No	No	No
Lack of space	No	No	No	No
Noise	No	No	No	No
Dirt	No	No	No	No
Vandalism and crime	No	No	No	No
Washing machine	Yes	Yes	Yes	Yes
Colour TV	Yes	Yes	Yes	Yes
Computer	No	Yes	Yes	Yes
Phone	Yes	Yes	Yes	Yes

Equivalised income	2nd Band 50,000-149,999 CZK	3rd Band 150,000-249,999 CZK	4th Band 250,000-349,999 CZK	5th Band 350,000-449,999 CZK
Car	No	Yes	Yes	Yes
Rent arrears	No	No	No	No
Arrears for heat, electricity, gas and water payments	No	No	No	No
Mortgage debts	No	No	No	No
Arrears on loans and credit repayments	No	No	No	No
Meat every other day	Yes	Yes	Yes	Yes
Week-long holiday away from home	No	Yes	Yes	Yes
Covering an unexpected expense	No	Yes	Yes	Yes

IV: *Connections between housing parameters and equivalised income 2014*

Equivalised income	2nd Band 50,000-149,999 CZK	3rd Band 150,000-249,999 CZK	4th Band 250,000-349,999 CZK	5th Band 350,000-449,999 CZK
Type of house	Apartment block with 10 or more apartments	Apartment block with 10 or more apartments	Apartment block with 10 or more apartments	-
Type of apartment (legal usage category)	Own house	Own house	Own house	-
Mortgage	No	No	No	No
Type of rent (if rental apartment)	No	No	No	No
Bathroom and toilet	Yes	Yes	Yes	Yes
Number of rooms	3	3	3	-
Apartment area	-	80	-	-
Damp	No	No	No	No
Lack of light	No	No	No	No
Lack of space	No	No	No	No
Noise	No	No	No	No
Dirt	No	No	No	No
Vandalism and crime	No	No	No	No
Washing machine	Yes	Yes	Yes	Yes
Colour TV	Yes	Yes	Yes	Yes
Computer	No	Yes	Yes	Yes
Phone	Yes	Yes	Yes	Yes
Car	No	Yes	Yes	Yes
Rent arrears	No	No	No	-
Arrears for heat, electricity, gas and water payments	No	No	No	No
Mortgage debts	No	No	No	No
Arrears on loans and credit repayments	No	No	No	No
Meat every other day	Yes	Yes	Yes	Yes
Week-long holiday away from home	No	Yes	Yes	Yes
Covering an unexpected expense	No	Yes	Yes	Yes

3: *Connections between equivalised income bands (EKVI_SKUP) and housing parameters 2014*

CONCLUSION

In the various models for the years 2005, 2010 and 2014 there appear the same and in part different significant attributes, for which, by means of selected algorithms, we have shown their influence on the amount of the annual equivalised disposable income in Czech households.

Variables excluded (factors without influence)

In all these years we were able to rule out the number of households in the home. The conclusion that the number of households in the home has no impact on the amount of equivalised disposable income is at first sight surprising, but this is most likely due to the fact that 98.95 % of Czech households do not share their home.

Between 2005 and 2014 three attributes pertaining to the home geographical location of the household were ruled out. These two models concur that income is not affected by the region in which the household dwells, the municipality size and type, nor the level of urbanization.

Selected variables affecting income

All three models concur on several factors that affect the equivalised disposable income:

The number of household members, the number of economically active members, and the number of consumer units

The type of household in terms of family completeness and by type of economic activity, as defined by the EU and OECD

Social class of the head of the household, age and the age at marriage of the head person, education, economic activity, employment type, industry sector and the number of months receiving wages

The influence of attributes relating to the number of household members is obvious, more persons increase household income. The number of consumer units is a variable set by the EU, and represents a total for all persons in a household whereby the consumer unit level for individuals depends on

the composition of the household and the age of the children. The persons at the head of households with the highest income have the highest coefficient. The EU methodology also stipulates that the equivalised disposable income is a function of the number of consumer units in the household. Household income is related to household type. The EU sets out the types of households by the number of adults, their age (younger or older than 65) and the number of children. The OECD specifies the kind of household by the employment of adult members, which agrees well with the Czech methodology – segmentation by economic activity.

The important variables affecting the level of equivalised disposable income are the demographic factors of the person at the head of the household, such as age, age at marriage or education. Education relates to the employment type and industry sector, which are other major factors. Household size, age, and education of the person at the head of the household are also some of the determinants of family incomes confirmed in a study concerning Vietnam (Tuyen, 2015).

Undoubtedly one factor affecting the level of income is economic activity, which was shown in the models twice over, with the significant variables being household type by economic activity as well as the head of the household economic activity variable.

Economic activity and employment are often specified as among the fundamental determinants of income. The direct impact of employment on household disposable income was shown by Škare and Stjepanović (2014) in their panel-based research study with data from the world's economies. As well as education and age, the variable of the head of the household's economic activity is considered by Lux (2000) in his study of Czech households to be a major socio-demographic factor, affecting disposable household income, from which consumer behaviour derives.

Quality of housing by equivalised income

In the second part of the study we investigated the connections between parameters that determine housing quality, and annual equivalised income. For each year the housing parameters that characterize the given income band are determined.

In all the three years studied, with strong ties between the elements, it was confirmed that lower income bands (here being an annual income up to 149,999 CZK) have lower quality housing, cannot afford some of the articles of long-term use (computer, car), cannot afford to go on holiday for a week outside the home or could not pay for an unexpected expense. This would probably lead to the household going into debt, but so far it appears that households in none of the areas studied are in debt.

With respect to the study on the expenditure of Czech households, the present study is in agreement about the differences between the lowest and higher income groups, since Lux (2000) shows that the weakest households can afford expenditure only on basic needs such as food and housing, and nothing on extras such as a car or a holiday.

Some income inequality is noted by Keeley (2015), who stresses that these differences in income are growing, the gap between the rich and poor is widening, and this is not good for society. The poor do not have enough resources to invest in education, and have inferior health. Conversely, the rich get richer, the banks are deploying their savings and supporting investment in the economy, but it could turn out that the wealthy may abuse their power to influence policies in their own favour (Keeley, 2015).

The fact that living conditions and the quality of housing derive mostly from income level is pointed out by Hussain and Rashid (2015) in their examination of the differences in quality of housing between poor and rich households. Higher income leads to a higher quality of housing, and also allows access to health care and education. According to the research the income level of the poor and the rich is influenced by education, economic activity and the employment sector of the person at the head of household. The lowest income and thus the lowest quality housing appertains to those working in agriculture (Hussain and Rashid, 2015).

On the other hand, none of the income categories examined here has problems with housing in terms of noise, damp, dirt, lack of space, light or vandalism and crime.

In the second, third and fourth income bands our testing revealed many connections showing that these people mostly inhabit their own houses or apartments, not paying rent.

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